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EUROPEAN PATENT APPLICATION

21 Application number: 80303515.3

51 Int. Cl.³: B 41 M 3/10
B 41 M 5/10

22 Date of filing: 06.10.80

30 Priority: 22.10.79 GB 7936520

43 Date of publication of application:
29.04.81 Bulletin 81/17

84 Designated Contracting States:
AT BE CH DE FR GB IT LI LU NL SE

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54 Sheet material carrying an unobtrusive image and method for its production.

57 An unobtrusive image is applied to paper or other sheet material by means of a charged droplet printer, for example an ink jet printer. The unobtrusive image applied may perform the function usually associated with a watermark in paper, but in contrast to a watermark, may be applied to papers during their production on high speed wide deckle machines or to coated papers. The method is particularly suitable for unobtrusively imaging pressure-sensitive copying material.

EP 0 027 698 A2

It has now been found that printing techniques in which electrically charged marking material droplets are projected through an electric or magnetic field which guides their path on to a material to be printed afford a means of
5 applying a feint or unobtrusive image to coated or uncoated paper or to other sheet material, even where high speeds of production or wide decks are involved. Such printing techniques, which include ink-jet printing and electrostatic screen printing, will hereafter be referred to as charged
10 droplet printing techniques. They are in themselves well-known. Ink-jet printing is described, for example, in an article entitled "Jet Set" in British Printer, June 1980, and in UK Patents Nos. 1 354 890, 1 432 366, 1 461 385, 1 462 193, 1 464 370, 1 479 963, 1 491 234, 1 500 908 and
15 1 533 659.

According to a first aspect of the invention, there is provided sheet material carrying an unobtrusive image applied by charged droplet printing, preferably ink-jet printing.

20 According to a second aspect of the invention, there is provided a method of producing sheet material carrying an unobtrusive image, comprising the step of applying the image to the sheet material by means of a charged droplet printer, preferably an ink-jet printer.

25 The sheet material may for example be paper or coated paper. In a preferred embodiment of the present method, the printer is mounted on the paper-making or paper-coating machine on which the paper or coated paper is produced, whereby the web speed through the printer is the same as the web speed through
30 the machine. Normally, an array of printers will be provided across the width of the web.

both microcapsules and colour developer. Alternatively, the microcapsules and the colour developer may both be present within the thickness of the sheet. As an alternative to the use of microcapsules (except in the last-mentioned
5 embodiment) the colour former solution may be present as globules in a pressure-rupturable coated matrix, for example of gelatine, or wax.

The present method may be used to apply a feint or unobtrusive image to either surface of the upper, lower or
10 intermediate sheets of a transfer system as just described or to either surface of a self-contained sheet as just described.

The reactants used in pressure sensitive copying material for feint or unobtrusive imaging by the present method may be
15 conventional, for example the colour formers may be fluorans, phthalides or spirobipyranes and the colour developers may be, for example, acidic clays, phenolic resins or salts of certain aromatic acids. Alternatively, one reactant may be an aromatic solvent solution of N,N'-di-benzyl-di-thio-oxamide
20 and the other reactant may be a nickel rosinate derivative. Since the nature of pressure sensitive copying material is now very well known and is described very extensively in the patent literature, further details will not be given herein.

Care must of course be taken to see that the ink or other
25 marking material used for the feint or unobtrusive image in a pressure-sensitive copying system does not de-sensitize the reactants or otherwise impair the functional performance of the copying system. Similar considerations of course apply to other sheet materials carrying functional coatings.

The rig incorporated an ink gun 1 having a single nozzle 2 adapted to emit a stream of ink droplets 5 in conventional manner. The nozzle 2 was positioned generally above a paper support platform 3 which was movable in two directions x, y at right angles to one another, and to the direction Z of ink droplet emission. Movement of the paper support platform 3 was controlled by punched tape such that ink droplets impinging on the paper could be made to form a desired image. The nozzle had a diameter of about 75 microns and was arranged to be pulsed so as to effect ink droplet formation. Deflector plates 4 were positioned near the nozzle so as to deflect certain of the ink droplets 5 on to the paper (only one deflected drop 7 is shown). A gutter 6 was positioned beneath the nozzle for collecting undeflected ink droplets.

A sheet of clay-coated colour developing paper ("Idem"* CF57 supplied by Wiggins Teape) was positioned (clay-coated side uppermost) on the paper support platform and the rig was operated to produce an unobtrusive image on the sheet. The ink used was a conventional ink jet printing ink except that it was of very much lighter intensity than is used for standard printing operations. The pulse frequency was 64 KHz, which gave ink droplets of approximately 140 microns diameter, and the deflecting voltage was adjusted until the desired angle of deflection was achieved. The deflection voltage was maintained constant so that each deflected droplet was deflected to the same extent. The arrangement was such that only about one droplet per thousand emitted droplets were actually deflected. The distance of travel before each deflected droplet impinged on the paper was about 70mm. It was found that the resultant dot diameter on the imaged paper was about 400 microns.

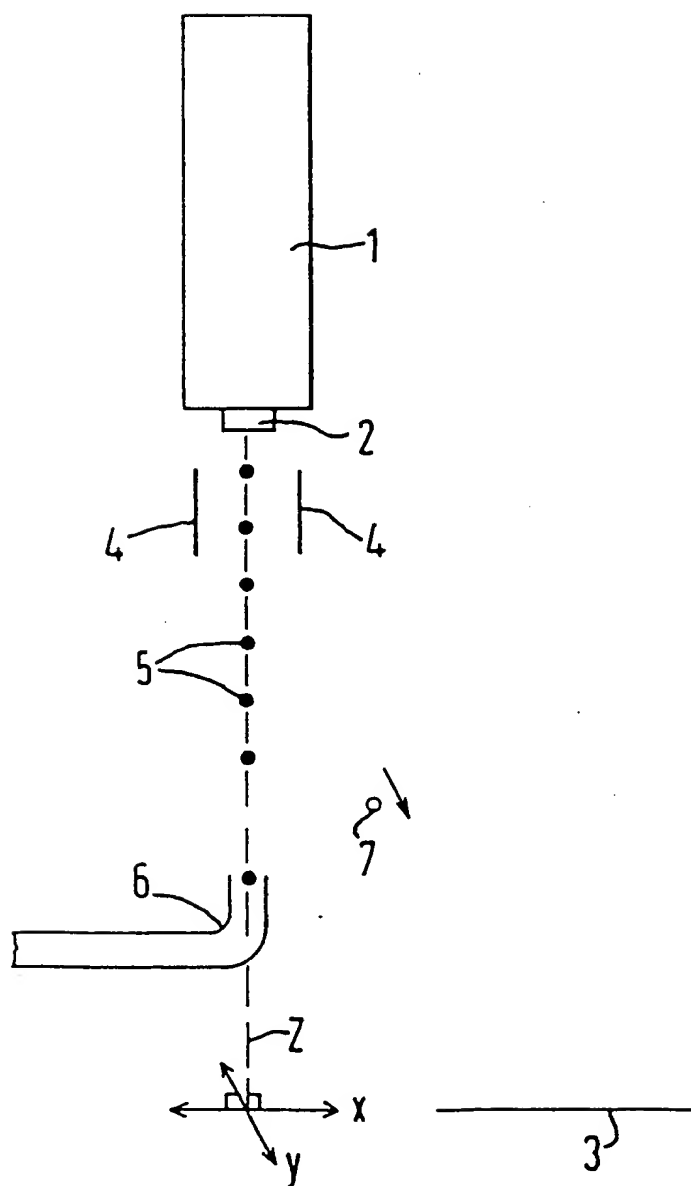
The papers unobtrusively printed were as follows :-

- a) standard 49 gm^{-2} base paper of the kind used commercially in the manufacture of "Idem" pressure-sensitive copying paper.
- b) clay-coated colour developing paper ("Idem"* CF 46 supplied by Wiggins Teape)- in some runs the coated surface was imaged and in others the uncoated surface.
- c) "Idem"* CF 46 coated on its surface not carrying the clay coating with colour-former containing microcapsules and particulate stilt material (ground cellulose fibre floc) serving to protect the microcapsules from premature rupture during handling and storage of the paper (the microcapsule coating was applied by the coating machine on which the printer was mounted) - in some runs the clay-coated surface was imaged and in others the microcapsule coated surface.
- d) standard 49 gm^{-2} base paper as described in (a) but coated on one surface with a microcapsule coating as described in (c) - in some runs the coated surface was imaged and in others the uncoated surface

When the printed coated papers described above were assembled into a pressure-sensitive copying set, the set functioned satisfactorily.

*"Idem" is a Registered Trade Mark

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Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number:

0 027 698
A3

(12)

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(43) Date of publication of application:
29.04.81 Bulletin 81/17

(88) Date of deferred publication of search report: 30.12.81

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EP 0 027 698 A3